simulations in 3D Warp will track the electron cloud in the ILC wiggler and will help find limiting parameters for the cloud.

Effect of Pipes in a Tank to be Purged of Oxygen. *Laura Zantout* (*University of Minnesota, Minneapolis, MN*)*; Stephen Pordes* (*Fermi National Accelerator Laboratory, Batavia, IL*). To produce a viable 50-kton LArTPC (liquid argon time projection chamber), as proposed, the liquid argon within must reach a purity level of 10 ppt oxygen. The purpose of the Daisy experiment is to determine if pipes used as structural components inside this detector would trap air and cause virtual leaks. A 2-cubic-foot tank filled with 50 half-inch diameter pipes was used to simulate the structure that would be within the detector. As argon flowed through the tank, oxygen levels were monitored both on the gas outlet and within using monitors of various sensitivities. Several variations were run: with an internal fan, without a fan, and with one end of the pipes capped. Plots of percent oxygen vs. time for all of the runs were fit well by perfect mixing equations. This suggests that oxygen was not trapped in the pipes, but instead diffused out quickly. Other turbulence (such as convection currents) may have also accounted for some mixing, especially in the capped run. It appears that building a structure of much longer pipes will not contaminate the liquid argon inside a detector via virtual leaks, as long as mixing through diffusion is given time to progress, or sped up by a fan.

Research and Development of Solution SAXS Data Analysis Methods. *Juliette Zerick* (*University of Mary Washington, Fredericksburg, VA*)*; Kenneth Frankel* (*Lawrence Berkeley National Laboratory, Berkley, CA*). The analysis of solution small angle X-ray scattering (SAXS) data is made difficult by the lack of vigorous and open source data reduction tools. Although singular value decomposition (SVD) has proven effective and practical in the analysis of SAXS data, it is not robust to experimental noise. Additional techniques must be utilized to extract meaningful results from a dataset; autocorrelation tests, chi-square tests for goodness of fit, visual inspection, and other methods are used for this purpose. However, little research has been done on the mathematical justification for their use. In this paper, the soundness and effectiveness of the application of these methods to experimental data were evaluated. It was found that all methods used were either unsupported by the mathematics or were insufficient to resolve the number of components in solution. Therefore, in an attempt to reduce the effects of experimental noise on the application of SVD, two new "pruning" methods were developed and tested on experimental SAXS data. By "pruning" from the dataset points that exhibited a small signal-to-noise ratio, or contained experimental error beyond a defined threshold, the application of SVD to the truncated dataset resolved the number of components in solution with greater accuracy than previous methods alone. The research and development of these methods were performed in order to enhance currently-used techniques and assist in the data analysis of two projects: Structural Cell Biology of DNA Repair Machines (SBDR) and Molecular Assemblies, Genes, and Genomics Integrated Efficiently (MAGGIE). The preliminary results of this undertaking will be released to the SAXS community to spur development of better data analysis methods. The software implementation of the recommended methods will be released under the GNU General Public License (open source), available at the Structurally-Integrated Biology for Life Sciences (SIBYLS) beamline website.

Simulating Multipacting in Tapered Waveguides Using Xing RK4. *Dan Zou* (*University of Wisconsin – Madison, Madison, WI*)*; Haipeng Wang* (*Thomas Jefferson National Accelerator Facility, Newport News, VA*). Radio frequency (RF) waveguides propagate and couple high RF power that is used to accelerate charged particles over short distances. Under certain resonant conditions in the waveguide, this high power can lead to undesirable discharging, or multipacting, consuming the RF power and possibly damaging the waveguide. One method of preventing multipaction is by avoiding these specific resonant conditions, which are most efficiently found by using appropriate computer simulation software. Xing RK4, written in FORTRAN, is one such software, though originally limited to rectangular waveguide analysis. The purpose of this study was to port Xing RK4 to C++, then to expand it to analyze multipaction in tapered waveguides. Expansion of Xing focused primarily on deriving appropriate empirical and analytic formulae for the electromagnetic (EM) fields within tapered structures. The majority of other necessary functions were inherited from the original code, slightly modified to accommodate the new geometry. EM field implementation was not completed due to time constraints and complexity of the analysis. Once completed, however, Xing RK4's new capabilities will allow scientists to determine the resonant conditions to avoid when using tapered RF waveguides and to benchmark other simulation codes. Additional accuracy may be achieved through further fine-tuning of the analytic formulae.

1-D Simulations of Metallic Foams Heated by Ion Beam Energy Deposition. *Alex Zylstra* (*Pomona College, Claremont, CA*); *John Barnard* (*Lawrence Berkeley National Laboratory, Berkley, CA*). One dimensional simulations of various initial average density aluminum foams (modeled as slabs of solid metal separated by low density regions) heated by volumetric energy deposition have been conducted with a Lagrangian hydrodynamics code, DISH (Deeply Simplified Hydrodynamics by R. More), using a van der Waals equation of state (EOS). The resulting behavior has been described to facilitate the design of future warm dense matter (WDM) experiments. Deposition in the simulations ranges from 15 to 30 kJ/g total energy and from 0.075 to 0.9 ns total pulse length, resulting in temperatures from 1 to 4 eV. The peak temperature reached in the foam was found to be greater than linearly dependent on the energy deposition, increasing with increasing density to a peak at approximately 75% solid initial average density and decreasing rapidly with increasing density beyond that peak, and essentially independent of the pulse length for pulse lengths shorter than the macro hydro time, approximately 1 ns. The peak pressure increases rapidly with increasing density, increases with increasing energy, and is roughly independent of the pulse length for lengths on the order of the macro hydro time. For pulse lengths of approximately the hydro time for one slab of the foam (~0.1 ns) an increase in the maximum pressure is observed. The expansion velocity is proportional to the density for pulses on the order of the hydro time of one slab of the foam; for longer pulses a dramatic increase in the expansion velocity is observed at approximately 75% solid density initial. We find that the homogenization time of the foam increases with increasing pulse length, and the remaining inhomogeneities in the homogenized foam decrease with increasing density. These results will help future experiments examine the equation of state in the WDM regime.

Science Policy

Strategic Planning for the Neutron Sciences Directorate: The Suggested Guidelines for the Content and Layout of the Annual Report. *Kelley Coffman* (*Vanderbilt University, Nashville, TN*)*; Al Ekkebus* (*Oak Ridge National Laboratory, Oak Ridge, TN*). The Oak Ridge National Laboratory Neutron Sciences Directorate (NScD) encompasses two world-class user facilities for studying materials with neutron scattering — the Spallation Neutron Source (SNS) and the High Flux Isotope Reactor (HFIR). As the Neutron Sciences' facilities emerge into a competitive worldwide market, a need exists for outreach to the scientific community. The larger component of my project involves outreach to a variety of audiences through scientific writing and creative design. More specifically, I headed the strategic planning of several neutron sciences publications such as scientific application fact sheets, a user orientation packet, and the future annual report. An annual report highlights achievements, developments, and operations of each facility and will be a requirement of the NScD once both facilities become operational. In conjunction with my strategic planning project, I formulated suggestions for the content and layout of the publication after engaging in research methods such as benchmarking, surveying, and outlining. The first step in outlining the report involved formulating a table of contents, which required benchmarking other top neutron facilities' reports. Additionally, I interviewed and surveyed NScD staff and scientists as well as the public and internal websites to integrate the missions and priorities into my suggestions. This also resulted in an array of perspectives on which aspects of the design should be emphasized. I then compiled an outline of my suggestions for content combining both tried and unique approaches to each section such as the page lengths, the groups to consult for information in each section, and the topics to address. In addition, I designed sample layout pages to illustrate my recommendations using advanced design software. The suggestions formulated for the NScD annual report strive to bridge the need for public outreach with representing two world-class neutron facilities.

Collaboration and Implementation of Disruptive Technologies in the Emergency Response Environment (I-ReSCUE). *Carter Dedrick* (*University of Memphis, Memphis, TN*); *Donald E. Vinson* (*Oak Ridge National Laboratory, Oak Ridge, TN*). Emergency response operation and networks are naturally collaborative in nature; however, due to recent catastrophic events and legislation, these networks have been encouraged to become more centralized. There is ongoing research at Oak Ridge National Laboratory involving the adaptation of existing technologies to National Security solutions. The goals for my

part of the project are to describe ways in which beneficial Disruptive Technologies act as a decentralizing force within the emergency response environment on a local level, diagram the overall emergency response environment and propose a theory for an improved planning and response tool. This is accomplished through literature review, interviews, and analysis of current response tools available. Research was conducted to develop theory for an interactive emergency response program to be constructed on an existing platform and explore how Disruptive Technologies can best be utilized. Compartmentalization of resources within emergency response cultures result in slow growth of innovations within the emergency response environment. Research into the connections of these networks is mapped and the ideal response network discussed. Requirements include management of interagency agreements, the ability to expand vertically and horizontally as needed for response to changing events, and include non-profit representatives. Collaboration in emergency response networks is currently carried out, and can be mapped on vertical as well as horizontal axes. The vertical collaboration axis begins with the local EMA (emergency management agency) and expands upward as events grow larger to include the state and Federal EMA. The horizontal collaboration axis shows the relationship between nonprofit and other NGOs (non-governmental organizations) to the vertical collaboration within the public sector EMA. Collaboration is best facilitated by policies that allow responders to create connections as opposed to those that merely limit abilities. Disruptive Technologies must be embraced and utilized on a wide and daily basis in order to be useful in the event of an emergency.

Impact Assessment of Plug-In Hybrid Electric Vehicles. *Alexander Exarhos* (*Grinnell College, Grinnell, IA*)*; Michael Kintner-Meyer* (*Pacific Northwest National Laboratory, Richland, WA*). Plug-in hybrid electric vehicles (PHEVs) have been considered and analyzed as a means of reducing dependency on foreign petroleum and reducing greenhouse gas emissions. PHEVs store energy supplied by the power grid in an onboard battery to support the vehicle to drive only on electricity or in an electric-assist mode that utilizes both the electric motor and the internal gasoline engine. PHEVs overcome the limited driving range shortcoming that limited the market acceptance of electric vehicles in the 90s by using the gasoline engine for distances that exceed the battery's driving range. A brief study was conducted that analyzed the impacts of PHEVs on the gasoline consumption and CO_2 emissions in the US. The analysis was based on a spreadsheet tool that models the effects of a set of PHEV penetration scenarios with varying market shares (25, 50, and 100 percent) of the light duty vehicle fleet (i.e., cars, pickup trucks, vans, sport utility vehicles). The same tool was also used to explore policy options that would achieve a stabilization of CO_2 emissions in the Northwest. The results showed that PHEVs could have a significant impact on reducing CO_2 emissions and on reducing gasoline consumption. This tool also showed that emissions and consumption could be stabilized if the fleet average fuel economy were to grow at the same rate as the fleet, resulting in 34 miles per gallon by 2050 if started in 2018. Similarly, CO_2 emission stabilization can also be achieved with a PHEV penetration trajectory that accurately off-sets the incremental emissions from a growing future vehicle stock. The potential of PHEVs to reduce gasoline consumption and harmful emissions emphasizes the environmental benefits of this emerging technology, and it sets the stage for future research into the technical problems facing PHEVs.

Evaluation of Compliance with Safe Standard Practices and Uses of Class II Biological Safety Cabinets Used in Biosafety Level 2 Laboratories. *Peter Hoang* (*Dominican University of California, San Rafael, CA*)*; Leslie A. Hofherr* (*Lawrence Livermore National Laboratory, Livermore, CA*). Biosafety Level 2 (BSL-2) laboratories contain operations involving biological risk agents such as infectious microorganisms associated with various human diseases that are of moderate potential hazard to lab personnel and the environment. When working with these agents, there is a risk from aerosol or splash production of biohazardous materials that can contaminate laboratory personnel, their work area, and the environment. Safety regulations, requirements, and guidelines developed by the Center for Disease Control & Prevention (CDC) and the National Institute of Health (NIH) recommend the use of physical containment devices to help minimize such exposure during BSL-2 operations. Biological safety cabinets (BSC) are one of the most effective primary barriers for such hazards. Based on these national documents along with the biosafety requirements and guidelines contained in the Lawrence Livermore National Laboratory (LLNL) Environmental Safety and Health Manual (ES&HM), a compliance survey was created to assess how well LLNL personnel implement appropriate BSC safety etiquette and procedures. The survey's questions consisted of topics chosen at the discretion of the surveyor. Eight researchers from eight of the forty-seven LLNL BSL-2 facilities were interviewed and their operations and workplaces were evaluated. All eight of the operations reviewed in this assessment had at least one or more practices or controls that deviated from the guidelines or requirements stated in the LLNL and national safety documents of both the CDC and NIH. The most common issues identified included improper personal protective equipment (PPE) decontamination and disposal, lack of maintenance of the ultraviolet lamp, lack of a proper sharps container inside the BSC, lack of procedure for checking airflow, and lack of High Efficiency Particulate Air (HEPA) filter maintenance. The findings of this survey indicate that enhanced worker training and additional assurance evaluations along with more detailed guidelines in the ES&HM may be warranted. The survey results in the areas of decontamination and maintenance may serve to guide more detailed assessments in the future to identify additional actions that may help improve BSL-2 safety practices and procedures while using a BSC. This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Lifecycle Determination for Industrial Hygiene Portable Safety Equipment. *Jordan Klingsporn* (*University of Wisconsin – Green Bay, Green Bay, WI*)*; Gordon Miller* (*Lawrence Livermore National Laboratory, Livermore, CA*). A policy for industrial hygiene instrument lifecycle assessment is necessary to ensure quality equipment is maintained, sufficient instrument capability is provided, and maintenance and replacement costs are not excessive. Such a policy is needed to ensure laboratory resources are optimized during times of increasing fiscal constraints and high regulatory scrutiny. While formalized lifecycle assessment guidance and strategies are common for facility structures, capital equipment, and consumer products such as automobiles, home electronics, and appliances, such guidance is not readily available for smaller scale equipment such as portable safety instrumentation. A combination quantitative and qualitative approach was investigated to develop a defensible and transparent basis for performing lifecycle assessments to support an industrial hygiene instrument replacement policy. Several factors were compiled to aid in predicting the lifetime of an instrument using instrument performance history reviews, operational conditions, recommendations from manufacturers, and feedback from equipment users throughout the Department of Energy complex. Some of the primary factors that were found to impact instrument lifetime are: changes in equipment technology, cost effectiveness of replacement compared to repair, availability of parts and factory calibration services, total cost of replacement, performance history, and equipment replacement costs being justified by increased efficiency and/or capability. Utilizing the compiled data, a spreadsheet tool was developed to apply the lifetime factors to prioritizing current instrumentation for replacement, as well as determine longer-term replacement budget strategies. The instrument lifetime factors and policy developed by this effort were nominally intended for portable industrial hygiene instrumentation, but they could be readily applied to instruments with different functions. The Lawrence Livermore National Laboratory Industrial Hygiene Instrument Laboratory will use these factors, tools, and policy drafted by this research as part of their operational strategy to help ensure quality safety equipment is maintained while minimizing costs. This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48. UCRL-ABS-233244.

Best Educational Practices for Modern Day Teachers. *Megan Reben* (*St. Joseph's College, Patchogue, NY*)*; Gail Donoghue* (*Brookhaven National Laboratory, Upton, NY*). For as long as there have been teachers, there have been those who sought the best ways to educate our children. In order to stay ahead in this changing world, it is increasingly important to provide quality education to as many students as possible. In order to find or develop the most effective method of introducing educational material to students at the elementary level, this study intends to use peer reviewed articles and subsequent results concerning the types of teaching methods in question. By referencing the conclusions of previously published studies, the results are meant to show a complete and accurate detailing of each of the methods strong and weak points. Presently, the results are not conclusive due to several factors, including cost effective versus educational effectiveness issues. The success of any particular method is interpretive because the techniques used to teach are not solely judged by their ability to allow the student to retain the most knowledge. Some examples of practices that are proven to

give students an edge up are cooperated learning and even outreach programs like the one Brookhaven National Laboratory provides. The purpose of this study is to uncover the most effective method to be used in classrooms which will allow each and every student to reach his or her full potential. That being the case, it is important to develop some kind of progress report to correlate the techniques used and the advancement of the students.

Successful Integration of Staff and Users into Oak Ridge National Laboratory's Neutron Sciences Directorate. *Jennifer Stinnett* (*University of Tennessee, Knoxville, TN*)*; Chrissi Schnell* (*Oak Ridge National Laboratory, Oak Ridge, TN*). For any scientific research laboratory to become one of the foremost facilities, it is crucial to attract and retain the best employees. To do this, a laboratory must be attractive to employees not only within their field of research, but also with the way they present their community and its resources. Oak Ridge National Laboratory (ORNL) is no exception. My project involves researching and exploring different methods to help attract new staff and users and to then help integrate them into ORNL, and more specifically to my project, the Neutron Sciences Directorate (NScD). Previously, the NScD was relying on a website that provided inadequate information to incoming employees and visitors. The scope of information provided was minimal and the coverage was lacking. As part of my project, I surveyed, gathered and organized new information, and enhanced the content of the present information. Based on the needs expressed by new staff, the information ranged from how to get a social security card to a list of local movie theaters. The information collected was vast and varied, but was all relevant and informative, and was information of interest to new and/or international persons. My project also consisted of building a new web community for NScD employees. For this I used Publisher, Photoshop and PowerPoint. The community, tentatively entitled "Friendship Web" allows employees to connect to one another outside the office. Employees voluntarily register and create their own page; complete with a picture, contact information, and any optional personal information they wish to include. They are then able to select their interests/talents/activities from a database, which are also listed on their page. This allows NScD employees to log on and find colleagues with shared interests; helping foster stronger relationships and a healthier work environment. It is also crucial to helping new employees feel welcome, and can prove resourceful when needing to locate employees who speak certain languages for translation purposes. The final part of my project consists of photographically documenting the NScD. Upon completion of this portion, new organization charts will be constructed, and locating and identifying people will be easier than the current method, which is solely on the internet and is not comprehensive. My project makes the transition into ORNL's NScD seamless, and also creates a better work environment for those already employed.

Waste Management

Construction of a Functional Replica of the Transfer Chute in the Clean Transfer Area of the Alpha-Gamma Hot Cell Facility. *Eric Becker* (*University of Illinois, Urbana-Champaign, IL*); *Donal Preuss* (*Argonne National Laboratory, Argonne IL*). The Clean Transfer Area (CTA) is part of the Alpha-Gamma Hot Cell Facility (AGHCF) where 7-gallon drums containing Remote-Handled Transuranics (RH-TRU) are transferred to 30-gallon drums. The drums are lined with plastic pouches that are subsequently vacuum sealed and tightly covered for transportation off-site following the AGHCF-OPS-305 RH-TRU 30-gal Waste Drum Outloading procedure. The CTA is radioactively contaminated, however, making practicing the Waste Drum Outloading procedure in it unsafe. Workers may receive more than the allowed radiation dosage if they are in the CTA for long periods of time. The purpose of building a replica of the transfer chute in the CTA is to provide a safe environment for the radiation workers to practice the Waste Drum Outloading procedure while still using an accurate model of the structure they will be working with. The transfer chute in the CTA was measured both from the inside and outside using a sextant. The controlled area where the replica was constructed was also assessed for usable parts and existing structures. The final step in acquiring the necessary measurements was researching the parts that needed to be ordered from outside sources. The replica design was then drawn and reviewed by the Assistant Facility Manager of the AGHCF, in addition to a Cognizant Systems Engineer. The specified materials were then ordered, both from outside vendors and from the Argonne Central Shops. A procedure outlining the necessary materials, tools, and assembly steps was written to equip the persons responsible to complete the replica accurately, efficiently, and safely. Once the materials arrived, they were moved to the assembly area where the replica would be constructed. Construction proceeded as outlined in the assembly procedure, and completed on-time (July 16, 2007), allowing the radiological workers time to practice the operation before the actual outloading takes place. The execution of the assembly procedure was also documented in order for later disassembly and reassembly to take place.